A METHOD FOR THE DETERMINATION OF POTENTIALLY PROFITABLE SERVICE PATTERNS FOR COMMUTER AIR CARRIERS

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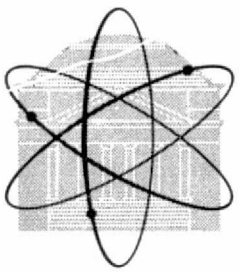

UNIVERSITY OF VIRGINIA

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SUMMARY

Accurate market demand forecasting is an essential element of any business enterprise. It is especially critical in the airline business because of the enormous cost of that first unit of service.

Most forecasting methods for market penetration and market generation rely upon extrapolations of known demand as identified from existing service patterns. Market conception forecasts, where a new transport mode of service is being contemplated, are extremely speculative. There is universal suspicion and little confidence in these forecasts.

A methodology for estimating market conception has been developed as a part of the Short-Haul Air Transportation program in the Department of Engineering Science and Systems of the University of Virginia. It is based upon an analysis of actual documents which provide a record of known travel history.

Applying this methodology a forecast was made of the demand for a new air feeder service between Charlottesville, Virginia and Dulles International Airport. In this case, local business travel vouchers and local travel agent records were selected to provide the documentation. The market was determined to be profitable for an 8-passenger Cessna 402B aircraft flying a 2-hour daily service pattern designed to mesh to the best extent possible with the connecting schedules at Dulles.

This example of the application of the forecasting method will be of great interest, because an entrepreneur, Cardinal Airlines, did initiate a service between Lynchburg - Charlottesville - Dulles on 15 September 1975; however Cardinal used a single 15-passenger Beech 99 commuter-type

airliner and a different schedule pattern. A forecast was subsequently made of this service and so an evaluation of this particular market conception forecast, on this route, will be available within a year.

The purpose of this report is to document the Charlottesville - Dulles air feeder service market conception forecast and its methodology.

CONCLUSIONS

It was concluded that:

1. The proposed methodology is a practical way of making market conception forecasts for a new mode of transportation.
2. The Charlottesville - Dulles market should be profitable at present with a properly designed service pattern and an 8-passenger aircraft such as the Cessna 402B

It is recommended that:

1. A market generation forecast of the Lynchburg-Dulles air feeder service should be made by the business records-travel agent records methodology described in this report.
2. A 6-months and a 12-months follow-up review be made of the Lynchburg-Charlottesville-Dulles market demand as identified from Cardinal Airlines passenger statistics, and compared to the forecast data.

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THE PROBLEM

INTRODUCTION

Accurate knowledge of market demand is an essential element of any business enterprise. It is especially important in the airline business because of the enormous cost of that first unit of service: A whole airplane and all the ancillary supporting systems must be provided for that first passenger trip.

Market estimation is difficult enough for the established trunk and local service airlines where they are basing their projections on an existing market. It has been almost solely speculative for a small commuter air carrier entrepreneur contemplating a new service where no present service or baseline market demand data exists.

DETAIL PROBLEM DISCUSSION

There are basically two types of market demand analyses; market penetration and market generation.

Market penetration analyses provide estimates of the expected share of an existing market which the new service expects to capture. The data are usually provided in terms of actual units (i.e., passengers, tons of freight, etc.) for the purpose of sizing the service, and percent of total market captured to provide for management with an indication of how well the service is doing against the competition.

Although fraught with uncertainty, market penetrations are generally the more accurate of the two predictions.

Market generation analyses provide estimates of the expected additional demand, above that already existing, which the presence of the new service will create. This becomes much more speculative, and airlines usually resist making market generation estimates. Frequently, they justify

market entry or expansion on expected market penetration and consider any market generation which may develop as an additional bonus.

There are numerous analytical methods of estimating market generation. This is because analysts generally do not accept any method but their own. They are all basically methods of extrapolating the existing market data by guessing what the future may be, and how it may influence past trends. The methods vary from very simple to very complex.

There is little correlation between their complexities and their accuracies however. This is because they all have a common weakness: the inherent inaccuracies of the assumptions of what the future may be and how it may influence past trends.

The results of the market generation analyses are much more sensitive to these input assumptions than they are to the method of analysis, no matter how sophisticated or highly computerized.

Note that these are all methods for extrapolating existing market data. If that data base does not exist, then none of these methods can be used. This is the case when an airline plans to introduce new service where none already exists. This is often the situation faced by a commuter carrier.

THE NEED

There is obviously, then, a need for a methodology of estimating market conception. Since all existing markets had to begin at sometime, there must have been ways. Very likely the entrepreneur simply "felt" that a market existed, and he took a huge chance. The high birth and mortality rates of new commuter air carriers support this hypothesis.

A methodology for estimating market conception has been developed as an activity of the Short-Haul Air Transportation Program in the Department of Engineering Science and Systems at the University of Virginia. This method should be of interest, because a private entrepreneur has actually inaugurated commuter air service (as of September 15, 1975) over the exact route estimated to be profitable by this analysis. A good evaluation of this methodology, for this particular market, will therefore be available within the year.

A SOLUTION

INTRODUCTION

The solution to the market conception forecast problem will be considered here, rather than market penetration or market generation. Of course, market conception and market generation are very similar, but the market conception term is meant to identify a situation where no service in the study mode presently exists.

Market conception includes both elements; diversion to the new mode from other existing modes (market penetration) and creation of new market demand from people who were not going to travel at all until this new service made the trip acceptable to them (market generation). Where it differs from these two approaches is in its source of baseline data.

This study will be described in three parts; Data Acquisition, Data Analysis, and Data Presentation.

DATA ACQUISITION

There are basically two methods of data acquisition:

- Already existing statistics of present modes, and
- Special surveys made specifically for a particular need.

Existing Data

Sources of existing market statistics include state highway surveys, industry travel surveys for other modes, local Chambers of Commerce, and records of traveler itineraries by all modes from company travel records or travel agent ticket stubs.

The major drawback of using these data is that they may not be directly suitable for your specific needs. There may be inconsistencies in such things as trip purpose, you don't know what the traveler's need really was: only what he accepted, you may count the same traveler more than once if using more than one data source. The data may not contain the specific information you need nor be in a readily usable form. However this method does have the advantage of being cheap and fairly easy to obtain and many of the difficulties can be avoided, as experience is gained by the investigator.

State highway departments make automobile travel surveys which can sometimes be utilized for market conception forecasts. The advantage is that the data are already available and may usually be obtained at little, if any, cost.

Market statistics on existing or past air service are reported quarterly by the Civil Aeronautics Board. This is the best source of data for existing air service. The data are reasonably reliable for service provided by certificated air carriers (i.e., trunk and local service). They may be very inaccurate when the service is provided by commuter airlines or when the traffic volume is very low.

Special Surveys

The other method of data acquisition, specific surveys, will cost more in time and money, but can obtain data on people's specific travel needs who are not now traveling. This is valuable for market conception studies, and can provide data specifically for your particular needs in a readily usable form.

There are several methods of obtaining this survey data. The easiest way is probably to sit down with a telephone directory, call random numbers and ask them a few questions.

This is direct, quick, relatively inexpensive, and provides some flexibility in questioning.

Unfortunately, it can be a pain in the neck to the interviewee whom you may inconvenience by your telephone call. It also requires an immediate, spontaneous answer which can be inaccurate or misleading. Extemporaneous impressions often bear little or no relation to historical fact.

A variation of the telephone survey is to mail out questionnaires to every Xth name in the telephone book. This will cost more than telephoning directly because outbound and return postage and envelopes must be provided. The advantage over direct telephoning is that the interviewee may respond at his convenience. Unfortunately that may be never. We have not yet tried this method, but it is worth considering.

Another way is for interviewers to make on-the-spot personal surveys. They can stand in airline, bus or train terminals interviewing passengers, or set up highway check points for motorists. Highway traffic surveys are difficult to do because they must be coordinated and accomplished through the state highway department and result in disruption of traffic. Terminal interviews on the other hand may be done with the simple permission of an industry or terminal official, but are of no value in covering what is perhaps, the single most important mode in the short-haul market - the automobile.

UVA Airport Surveys

Our experience with airport interviews has been very good, and the interviewees were quite happy to answer questions. They felt flattered, in fact, that we considered their views important.

The drawback of terminal surveys for market conception forecasts is that the potential passengers are not in the terminal. Either they are not traveling at all due to a lack of adequate service, or they have taken the universal transportation backup system: the private automobile.

The only potential travelers for market conception forecasts to be found in a terminal interview are those who would like to use the new service and coincidentally happen to be in the terminal at the time of the interview. The data are then accurate only to the extent that the same people generally make both kinds of trips.

UVA Direct Mail Survey

We conducted a trial direct mail survey in the Fall 1974 in which we sent general travel data questionnaires to 1700 Richmond, Virginia, homeowners. The interviewees' demographic characteristics were pre-selected from a direct mail marketing list broker's computer files to coincide with the demographic characteristics representative of actual travelers as found from other, on-site surveys. The object of the direct mail program was two-fold:

1. Evaluate the direct mail method of obtaining questionnaire response
2. Obtain some bona fide amodal travel habit data from a pre-selected demographic sampling of Richmond homeowners.

The program was inconclusive regarding both objectives because of the poor response rate of 12.1% (206 usable responses). This was felt to be caused by the failure of the list broker to include pre-paid postage on the reply envelopes, as specified in the contract. This, coupled with some extra expenses due to the research nature of the program, resulted in a cost per response of $4.85, which is not felt to be cost effective or representative.

A production mailing using first-class postage and "Dear Friend" letters of transmittal with the questionnaires would cost about 39.86¢ each, or $398.60 per thousand. A response rate of 24% would seem reasonable, and would result in a cost per response of $1.60.

The method was 94% accurate at pre-selecting the homeowner's sex, 46% accurate at pre-selecting his age bracket, but only 35% accurate at pre-selecting his income bracket. Only 14% were simultaneously accurate on all three characteristics. Undeliverable letters amounted to 15.9%. These data can be interpreted as a reflection on the accuracy of the commercially available mailing list used.

There was no significant difference in the response rates from the various mailing methods, which included the four combinations of first-class and third-class postage, with computerized personal letters and "Dear Friend" letters. The first-class postage with "Dear Friend" letters would be the preferred method for administrative reasons.

The questionnaire data has not been completely analyzed, but appears to be very good quality, even though small in quantity. The respondents were generally very candid and helpful with their replies. Due to the small response rate, however, any conclusions drawn from the data must be suspect.

Unfortunately, no conclusions or recommendations can be made regarding this method of data acquisition. The lack of pre-paid postage on the return envelopes obviously skewed the response rate data, which is critical to the cost-effectiveness of this method. The reader must be left to judge for himself, from this report, whether the method would be of value to him or not.

A report on the details of this project is provided in Appendix A.

UVA Survey of Travel Vouchers and Travel Agent Records

Data were sought in December 1974 on which to base market conception forecasts for a Charlottesville-Dulles Airport air feeder service. Such service did not then exist.

Travel data between 30 June 1972 and 30 June 1973 were obtained from University of Virginia travel vouchers from sponsored research expenditures. The following information was obtained from each voucher:

- Date of departure
- Date of return
- Destination
- Route of travel
- Mode of travel (this includes the private automobile)
- Person making the trip (used only to avoid counting the same traveler more than once)
- Whether or not tickets were purchased through a travel agent

Not all travel vouchers were written the same way. In some instances a trip was deduced by noting expenses incurred in another city by an individual living in Charlottesville and working for the University. In these cases the name of the individual incurring the expenses and the date of the expenditures were compared with travel agency invoices in an effort to determine the route of the trip. In all cases air transportation was determined as the mode of travel. If the route of the trip could not be determined by comparison with travel agency invoices, a notation was made indicating that transportation was by air and most likely through Washington National or Dulles airports.

The data are tabulated in Appendix B.

Stubs from all airline tickets issued by Blue Ridge Travel agency between 30 June 1972 and 30 June 1973 were examined. The air mode was the only mode used by Blue Ridge customers. The following information was obtained from each ticket stub:

- Date of Departure
- Date of return
- Destination
- Route of travel

Only those trips with segments through Washington airports were recorded. These data were corrected for flights already noted from the University records.

Many tickets started and/or terminated from National or Dulles. In these cases the assumption was made that the trip originated or terminated in Charlottesville since Blue Ridge Travel handled the ticket and was located in Charlottesville.

These data are tabulated in Appendix C. Additional data are tabulated in Appendices D through F.

It should be noted that these particular contacts were used in this case because they were convenient. For other studies in different localities, other data sources would probably be appropriate. Also, the objective of this particular study was to illustrate what could be accomplished by the technique, and not to conduct an exhaustive study.

DATA ANALYSIS

A typical problem may be defined as follows, which illustrates the general sequence of events during data analysis:

1. Identify a specific O-D* or feeder market for analysis which has low-frequency or non-existant service between a small city and a hub or major commercial area.

2. Determine the service need in this market by direct survey of travel habits of a cross-section of the local populace. Identify purpose of travel and final destination.

3. Identify any factors which may influence the market positively or negatively. These factors may be certain types of industry with a propensity for travel, population, personal income, institutions of higher education or government, condition and types of connecting highways or other modes of transportation.

4. Select a base for scaling the measured demand of step 2 to the total travel need of the community and predict the gross market.

5. Determine the desired service characteristics in terms of its convenience (routes and schedules), cost (fares), and comfort (minimum acceptable aircraft types or other factors).

6. Select candidate aircraft by matching routes, schedules, market forecast, reasonable passenger load factors, and aircraft direct operating costs.

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*O-D is an airline term designating passengers' origination-destination points as opposed to say a feeder service to a hub airport or intermediate airport stop or transfer.

7. Set up a practical operations schedule based on realistic aircraft capabilities, acceptable passenger load factors, and traveler needs and desires.

8. Estimate the gross passenger market based on the traveler's needs, the service to be provided, and the operational schedule.

9. Adjust the market capture for passenger acceptance of the particular aircraft considered. Passenger acceptance of a small, propellor aircraft will be strongly affected by length of time spent in the air and alternate choices of transportation.

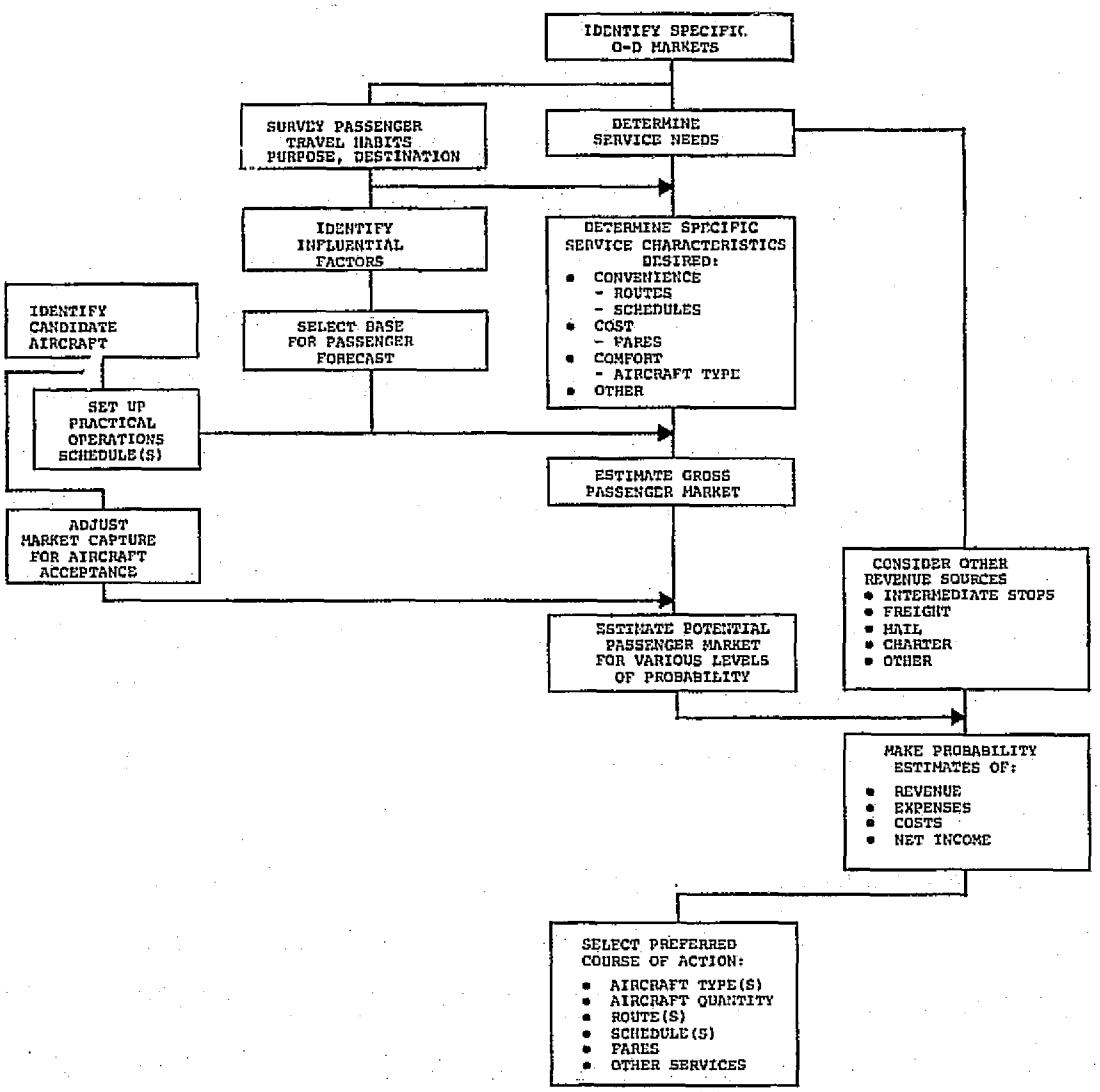
10. Estimate the potential passenger market penetration/generation for various probability levels.

11. Consider other business opportunities such as intermediate stops, air freight, mail, and charter.

12. Estimate total and itemized revenues, expenses, other costs, and net income for various levels of probability.

13. Adjust for fare levels. Select a preferred course of action. Include aircraft, selection and quantity, routes, schedules, fare structure and service details. Several options may be considered as alternatives if one course is not clearly superior than the others.

A data analysis outline for this process is shown in Figure 1.



DATA PRESENTATION

The method and content of data presentation greatly affect its usefulness. The required information should be provided for various service level options. These data fall generally into three categories; traffic data, financial data, and operational data.

Traffic Data

These data have to do with the market size and capture. It should include forecasts for the total idealized market, market penetration and generation, average passenger load factors, and lost business due to aircraft size, passenger acceptance, routes or flight schedules.

Financial Data

The financial data should include forecasts for fare structure, gross annual revenue, direct, indirect, and total operating costs (DOC, IOC, and TOC), a breakdown of fixed and variable costs, return on investment (ROI) and yield per available seat mile (¢/ASM).

Operational Data

Operational data should include types and number of aircraft, service schedules and routes, and annual utilization.

Service Options

The above data should be computed for various service levels and schedules, routes, and aircraft. Schedules, for example, should include hourly service and peak-periods-only, as well as other intermediate levels appropriate to specific requirements.

Assumptions

All assumptions should be fully documented and listed in a conspicuous place, and the analysis method should be described in an appendix.

Such studies frequently concentrate extensively on the analysis methods and rush over the assumptions. This is very bad and usually results in conclusions which lack credibility. This is because the results of the analysis are much more sensitive to the input assumptions than to the analysis method.

The assumptions listed should include unit costs of equipment, supplies, services and salaries, net fares (exclusive of ticket taxes) of proposed services and competitive modes, growth rates, market generation and penetration factors, market demand characteristics, and other factors appropriate to the specific problem.

Probability

The data should preferably be computed for various levels of probability, and the results presented in probabilistic form. This is the logical way of handling "soft" input assumptions and data. It also avoids the presumption of stating uncertain results as if they were fact.

A probabilistic analysis/presentation acknowledges that the entrepreneur is taking a gamble, and it quotes him the odds. It does not make his decision for him, but provides enough information for him to make a sound decision himself.

A probabilistic analysis is more expensive and time consuming than a deterministic analysis. A deterministic analysis may therefore be in order for first, preliminary estimates, with a follow-on probabilistic analysis in greater detail reserved for those service opportunities which seem the most promising.

THE EXAMPLE

Note:

This example is shown in its entirety, including Summary, Conclusions, and Recommendations. These sections are repeated in the front of this report for the clarity and convenience to the reader.

SUMMARY

Passenger data between Charlottesville and Washington, D. C., were obtained from University of Virginia travel vouchers from the Office of Sponsored Programs between June 30, 1972, and June 30, 1973, and from Blue Ridge Travel Agency ticket stubs for the same period. These accounted for about 10% of the total air passengers reported between Charlottesville and National Airport in the CAB Table 10 for that period. These data become the basis for predicting the 1975 passenger air market and feeder airline service viability between Charlottesville-Albemarle Airport and Dulles International Airport. That estimation is the subject of this report. There was no such service at the time. All air travel to the Washington, D. C. area was through Washington National Airport.

CONCLUSIONS

Based on this analysis, there appears to be a Charlottesville-Dulles passenger market roughly equal to the Charlottesville-National demand carried by Piedmont Airlines. A high frequency, scheduled feeder airline service using 8-passenger Cessna 402B aircraft is estimated to be a profitable venture. The identifiable market appears to be too small,

however, for frequently scheduled service with the larger, and more expensive, Twin Otter or Beech 99 commuter airlines.

RECOMMENDATIONS

Based on this study, it is recommended that a more detailed economic analysis be made using more realistic operating cost data.

ESTIMATION OF CHARLOTTESVILLE-DULLES MARKET

Gross Market Projection for the Data Base Year

The Charlottesville-Dulles market was estimated by determining the percentage of the identifiable Charlottesville-Dulles market related to the identifiable Charlottesville-National air market, and comparing this to the total CAB reported Charlottesville-National air market. The baseline is shown in Table 1.

Allowance for Market Growth

Historical growth rate for 1972-1973 (from CAB Table 10) was 14%. Since this period, however, two major perturbations have occurred in the market. The first was the energy crisis of early 1974 which caused travelers to switch from their autos to airplanes, and the second was the recession which is constraining air transportation growth in 1975. This makes market growth predictions very difficult. An attempt was made, however, with a view towards conservatism and the value used are shown in the 2nd column of Table 2 Market Penetration.

The potential Charlottesville-Dulles air market and revenue was estimated for several market penetration values and the March 1975 Piedmont Airlines fare of $21.30 (net of 8% ticket tax). These data are presented in Table 2. Note that this is market penetration, and no credit has been taken for market generation due to the new service convenience.

SUMMARY
ESTIMATED TRAFFIC AND FINANCIAL DATA
1975 CHO-IAD Market

	Hourly Service	2-Hour Service	Pax L.F. ≥ 30%	Peak Demand
TRAFFIC DATA				
Market Penetration	60%	43%	44%	44%
Aver. Pax L.F.	35%	51%	60%	69%
Lost business-seats	8%	6%	12%	11%
Lost business-sched	7%	26%	19%	20%
FINANCIAL DATA				
Gross annual rev.	$598,104	$431,964	$445,255	$438,609
Aver. rev/flt.	$ 59.90	$86.53	$101.94	$117.15
Est. ROI	128%	229%	69%	67%
Yield-¢/ASM	8.9	12.9	15.2	17.4
MISCELLANEOUS				
No. aircraft	2	1	2	2
Annual util.-hours	3328	3328	1456	1248

NOTES:

Total estimated market = 47,013 pax/year
Net fare = $21.30 (net of 8% ticket tax)
Aircraft unit cost = $131,400 (C402B)
Assumption: Total Operating Cost = Aircraft Unit Cost
"Pax L.F. ≥ 30%" denotes a service pattern where the average round-trip passenger load factor equals or exceeds 30%.
"Lost business-seats" denotes the additional passengers who would have flown if there had been room on the aircraft
"Lost business-sched" denotes the additional passengers who would have flown if the schedule had been more convenient for them.

Table 1
CHO-WAS TRAVEL DATA
Jun 30, 1972 - Jun 30, 1973
(one way)

Charlottesville To:	UVa Sample Data			CAB Data
	Air	Other	Total	Air
Dulles	72	1190	1262	0
National	1013	607	1620	20,120
Washington, D. C.	208	461	669	0
TOTAL	1293	2258	3551	20,120

Estimate of potential total Charlottesville-Dulles one-way market for Jun 30, 1972 - Jun 30, 1973 is:

$$\left(\frac{\text{Sample CHO-IAD total}}{\text{Total sample}}\right) \div \left(\frac{\text{Sample CHO-WAS air}}{\text{Total Sample}}\right) \times \left(\text{CAB CHO-WAS air}\right)$$

$$\left(\frac{1262}{3551}\right) \div \left(\frac{1293}{3551}\right) \times \left(20{,}120\right) = 19{,}638 \text{ O.W. pax/year}$$

$$= 39{,}276 \text{ R.T. pax/year}$$

Table 2
CHO-IAD ESTIMATED AIR MARKET AND REVENUE
Total Round Trip Market
(March 1975 Fare Level)
(Thousands of Dollars)

Year	Estimated Growth Rate	Market Penetration							
		100 %		75 %		50 %		25 %	
		Market	Rev.	Market	Rev.	Market	Rev.	Market	Rev.
1973	*14 %	39,276	$ 837	29,457	$ 627	19,638	$ 418	9,819	$ 209
1974	14	44,775	954	33,581	715	22,388	477	11,194	238
1975	5	47,013	1001	35,260	751	23,507	501	11,753	250
1976	8	50,774	1081	38,081	811	25,387	541	12,694	270
1977	10	55,852	1190	41,889	892	27,926	595	13,963	297
1978	10	61,437	1309	46,078	981	30,719	654	15,359	327
1979	10	67,581	1439	50,686	1080	33,791	720	16,895	360
1980	10	74,339	1583	55,754	1188	37,170	792	18,585	396

*Actual growth rate

Desired Service Characteristics

Passenger acceptance of a CHO-IAD feeder service, as shown by market penetration, will depend in large measure upon its perceived convenience. This is basically the interline connections with Dulles arriving and departing flights of interest to Charlottesville passengers. A time of day histogram of these Dulles flights is presented in Table 3. It was identified from UVa analysis of 1262 actual passenger tickets showing Dulles on their tickets. It is assumed that the time of day travel preferences will be the same at the time the service is inaugerated. To be ideally responsive the operator must continually monitor the demand for service out of Dulles.

Passengers per flight were estimated by assuming that the estimated annual passenger volume is equally distributed between the identified daily flights. These data are shown in Table 4, based on a six-day week, for the years 1975 through 1978.

A travel time analysis is tabulated in Table 5, and shows a 45- to 50-minute time savings of the air feeder service over the private automobile. It is therefore doubtful that significant market penetration could be made of passengers who had to wait very long for a feeder airline connection. Market penetration estimates for various waiting times are shown in Figure 2. These data are based on the rough assumptions that everyone will take the feeder flights if there is zero waiting time, and no one will take it if the waiting time reaches three hours. The first assumption is unrealistic for two reasons; first, 100% market penetration is practicably unattainable, and second, zero waiting time is also unattainable. The curve is therefore truncated at a waiting time of 45 minutes, which would result in

Table 3
DULLES MAJOR FLIGHT OPERATIONS
OF INTEREST TO CHARLOTTESVILLE PASSENGERS
(May 1974)

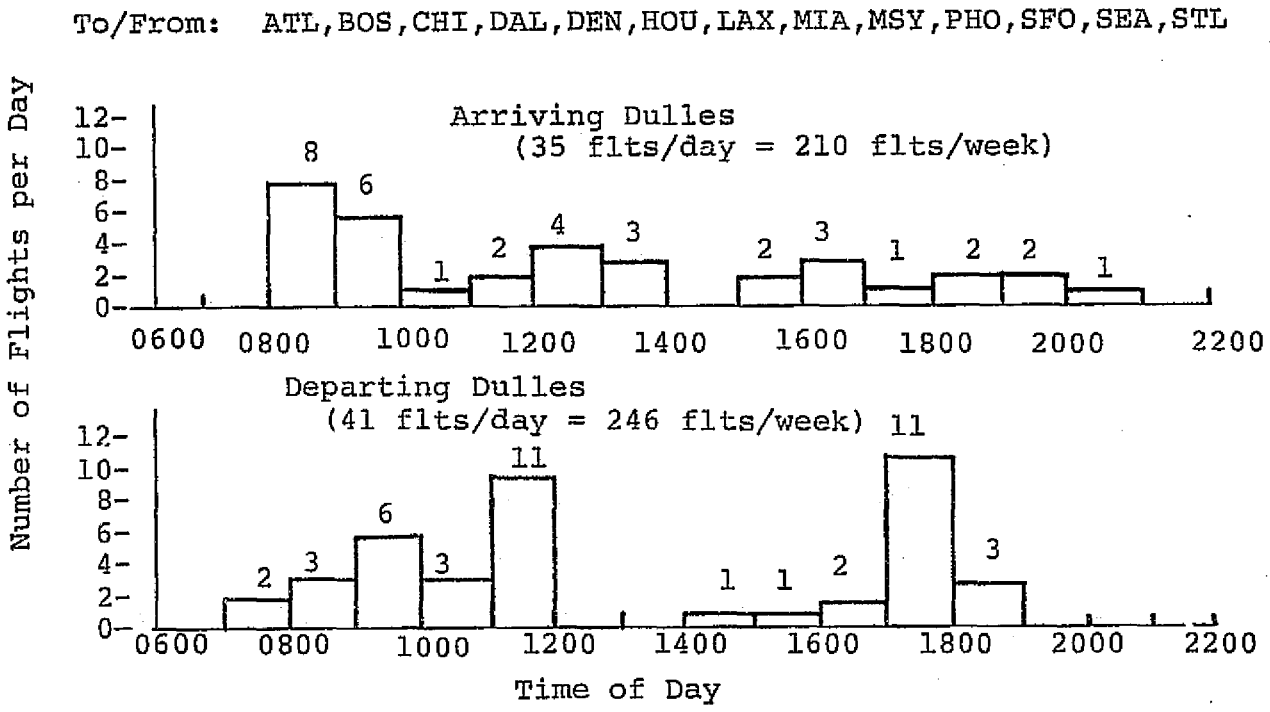


Table 4
ESTIMATED HOURLY PASSENGER FLOWS
(Dulles Long-Haul Passenger Arrivals/Departures)

Time of Day	CHO-IAD				IAD-CHO			
	1975	1976	1977	1978	1975	1976	1977	1978
0600-0700	0	0	0	0	0	0	0	0
0700-0800	* 4	4	4	5	0	0	0	0
0800-0900	6	6	7	7	17	19	20	23
0900-1000	11	12	13	14	13	14	15	17
1000-1100	6	6	7	7	2	2	3	3
1100-1200	17	18	20	22	4	5	5	6
1200-1300	0	0	0	0	7	9	10	11
1300-1400	0	0	0	0	6	7	8	8
1400-1500	2	2	2	2	0	0	0	0
1500-1600	2	2	2	2	4	5	5	6
1600-1700	4	4	4	5	6	7	8	8
1700-1800	20	22	24	26	2	2	3	3
1800-1900	6	6	7	7	4	5	5	6
1900-2000	0	0	0	0	4	5	5	6
2000-2100	0	0	0	0	2	2	3	3
2100-2200	0	0	0	0	0	0	0	0
TOTALS								
Daily	75	81	90	99	75	81	90	99
Weekly	452	488	537	591	452	488	537	591
Annual	23,506	25,387	27,926	30,718	23,509	25,387	27,926	30,718

(Six-day week) (Totals may not add up due to rounding)
(* 4 passengers wishing to go from CHO-IAD to depart IAD between 0700-0800 on a long-haul flight)

Table 5
TRAVEL TIME ANALYSIS
(CHO-IAD)

	Event	ELAPSED TIME - Hours Private Auto	 Air Service
IAD → CHO	Deplane @ IAD	0	0
	Depart IAD	:30	:30
	Arrive CHO	-	1:10
	Depart CHO	-	1:25
	Arrive Home	2:30	1:40
	Net Time Savings		:50
CHO → IAD	Leave Home	0	0
	Arrive CHO	-	:15
	Depart CHO	-	:35
	Arrive IAD	2:00	1:15
	Enplane @ IAD	2:30	1:45
	Net Time Savings		:45

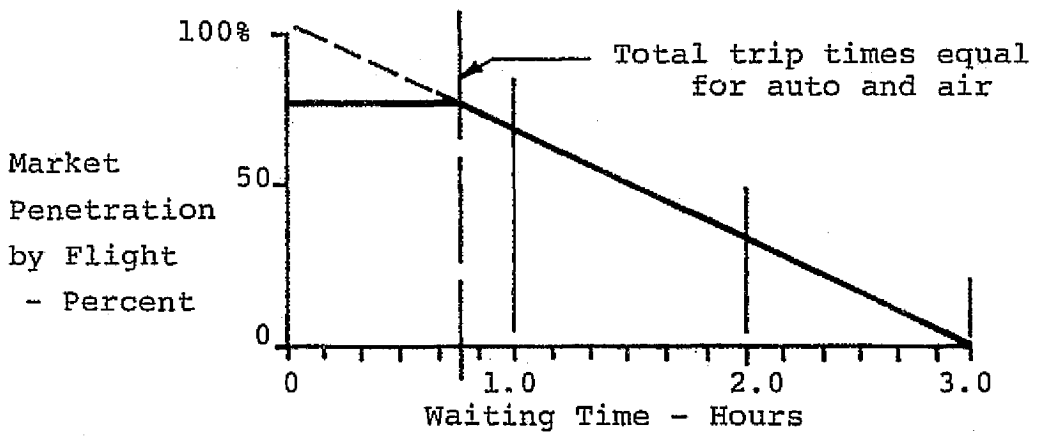


FIGURE 2

ESTIMATED MARKET PENETRATION FOR EACH FLIGHT CONNECTION

identical total travel times by private auto or feeder airline. The resulting maximum market penetration possible for a flight connection is therefore 75%, which is more realistic.

Market penetration for one-hour, two-hour, and three-hour waiting times are 65%, 40%, and zero, respectively. No market penetration penalty was taken due to possible adverse passenger reaction to the use of very small aircraft for the feeder service.

Sample CHO-IAD flight schedules and passenger loads are shown in Table 6.

Cost Estimates and Fare Structure

Estimated unit costs of various size candidate aircraft are shown in Table 7, based on a 6% annual inflation rate.

Based on the rule of thumb that an aircraft must generate gross annual revenues equal to its unit cost, these unit costs will indicate the revenue required for a viable service using that aircraft. This is true when aircraft depreciation as a percent of total operating costs equals the depreciation period, such as 10% and 10 years. This also means that the airline Total Operating Cost will equal the aircraft unit cost times total number of aircraft.

Market penetration is also a function of relative fare levels. For example, if the fare is lowered or raised 1%, over small ranges, a market increase or decrease of about 1% can generally be expected. Fare reduction would only be of value if it will fill seats that would otherwise be empty, with enough margin that the additional traffic would offset the lost revenue from those passengers who would have flown anyway. This will generally show up in the yield values.

Table 6
ESTIMATED PASSENGER ACCEPTANCE
(1975 Market)

Schedule Freq.	A/C No.	R.T. PAX L.F. -%	CHO→IAD				IAD→CHO			
			Arrive IAD	Avail. Pax	Accep Pax	Pax L.F.	Depart IAD	Avail. Pax	Accep. Pax	Pax L.F.
Hourly	1	19	0630	3	3	37.5	0645	0	0	0
	2	25	0730	4	4	50.0	0745	0	0	0
	1	44	0830	7	7	87.5	0845	0	0	0
	2	81	0930	4	5*	62.5	0945	11	8	100.0
	1	100	1030	11	8	100.0	1045	8	8	100.0
	2	6	1130	0	0	0	1145	1	1	12.5
	1	19	1230	0	0	0	1245	3	3	37.5
	2	38	1330	1	1	12.5	1345	5	5	62.5
	1	31	1430	1	1	12.5	1445	4	4	50.0
	2	31	1530	3	5*	62.5	1545	0	0	0
	1	69	1630	13	8	100.0	1645	3	3	37.5
	2	50	1730	4	4	50.0	1745	4	4	50.0
	1	6	1830	0	0	0	1845	1	1	12.5
	2	19	1930	0	0	0	1945	3	3	37.5
	1	19	2030	0	0	0	2045	3	3	37.5
	2	6	2130	0	0	0	2145	1	1	12.5
2-Hours	1	44	0730	7	7	87.5	0745	0	0	0
	1	100	0930	9	8	100.0	0945	11	8	100.0
	1	50	1130	0	0	0	1145	7	8	100.0
	1	50	1330	2	2	25.0	1345	6	6	75.0
	1	63	1530	9	8	100.0	1545	2	2	25.0
	1	63	1730	4	4	50.0	1745	6	6	75.0
	1	19	1930	0	0	0	1945	3	3	37.5
	1	19	2130	0	0	0	2145	3	3	37.5
Pax L.F. ≥ 30 %	1	44	0830	7	7	87.5	0845	0	0	0
	2	75	0930	4	4	50.0	0945	11	8	100.0
	1	100	1030	11	8	100.0	1045	8	8	100.0
	2	38	1330	1	1	12.5	1345	5	5	62.5
	1	31	1430	1	1	12.5	1445	4	4	50.0
	2	69	1630	13	8	100.0	1645	3	3	37.5
	1	63	1730	4	6	75.0	1745	4	4	50.0
Peak Period	1	44	0830	7	7	87.5	0845	0	0	0
	2	81	0930	4	5	62.5	0945	11	8	100.0
	1	100	1030	11	8	100.0	1045	8	8	100.0
	2	75	1430	3	5	62.5	1445	7	7	87.5
	1	63	1630	13	8	100.0	1645	2	2	25.0
	2	50	1730	4	4	50.0	1745	4	4	50.0

"Avail. Pax" denotes passengers who are expected to accept the service and schedule and fly.

"Accep. Pax" denotes passengers which the aircraft size allow to be carried and are accepted by the airline.

* Note that in some cases where the aircraft are full, a passenger may elect to fly to Dulles an hour early.

Table 7
CANDIDATE AIRCRAFT

Aircraft	Seats	1974 Actual Unit Costs	* Estimated Unit Cost			
			1975	1976	1977	1978
C402B	8	$124,000	$131,400	$139,300	$147,700	$156,500
Islander	10	** 110,500	117,130	124,158	131,607	139,503
B99	15	615,000	651,900	691,000	732,500	776,400
DHC-6	19	641,000	679,500	720,200	763,400	809,200
F-27A	30	445,500	472,200	500,600	530,600	562,400

*Current year dollars @ 6 % annual inflation rate

**Estimated

Actually, there is a small range of fare variations above and below the existing fares through which passengers perceive no difference. This range is known as "fare elasticity." No one really knows how great this range can be as a percentage of the original fare, but ± 5 to 10% would not be unusual. This "plateau" provides a range through which net revenues may probably be increased without running off many passengers. Estimates of the CHO-IAD market penetration variations for fare variation are shown in Table 8, which assumes a purely linear variation with no fare elasticity.

A Gallup Poll of 4467 adults conducted for American Express Corporation, as reported in Aviation Daily (September 12, 1975, page 70) substantiates the 1:1 relationship for business travel. This is shown in Figure 3. Vacation travel appears to be a bit more sensitive, but the 1:1 rule of thumb would appear to be a useful, conservative value.

Note that the breakeven point is not a 1:1 relationship. Market generation must increase 1.0% faster than fare reductions in order to break even for a fare reduction. This can be illustrated by the following example of a 10% fare decrease:

$$Pax_2 \times Fare_1 = Pax_1 \times Fare_1$$

$$Pax_2 = Pax_1 \times \frac{Fare_1}{Fare_2} = Pax_1 \times \left(\frac{1.00}{1.00 - .10}\right)$$

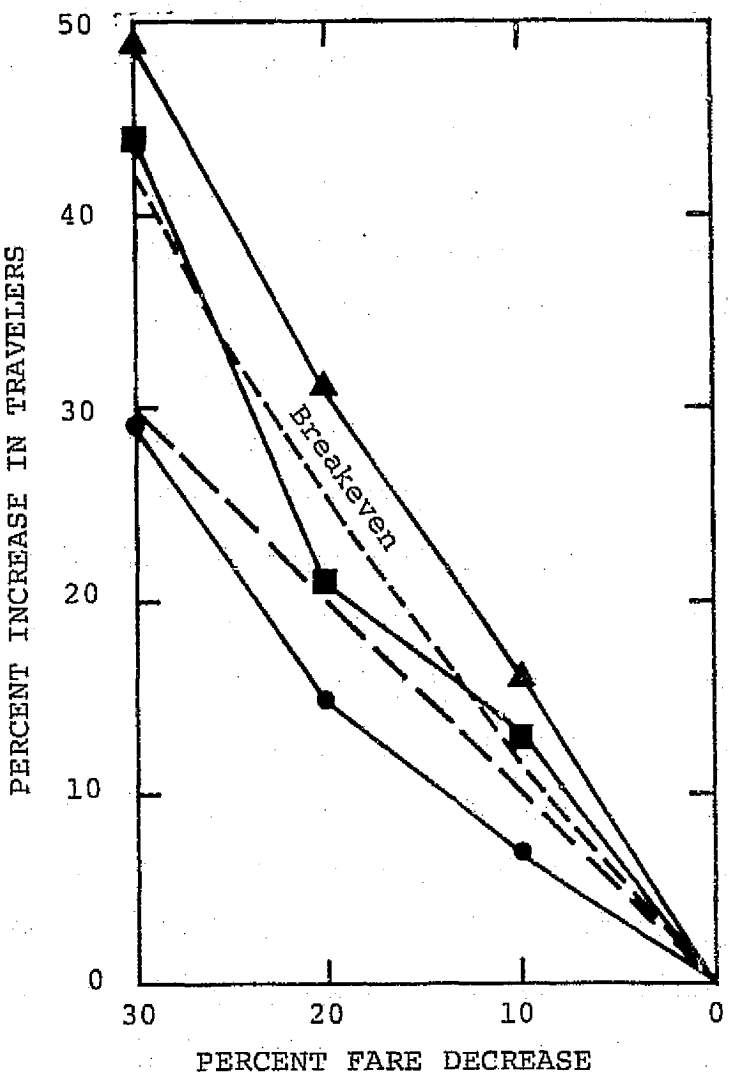
$$Pax_2 = Pax_1 \ (1.1111111)$$

For a fare increase, however, the opposite is true, and passengers do not need to increase as much:

Table 8
ESTIMATED MARKET PENETRATION VARIATION WITH FARE
(1975 Market)

Schedule	Fare Premium				
	-20%	-10%	0	+10%	+20%
Hourly	72	66	60	54	48
2-Hour	52	47	43	39	34
L.F. $\geq$ 30%	53	48	44	40	37
Peak	53	48	44	40	37

Fare = $21.30 (net of 8% ticket tax)



● - Business (paid)

■ - Business (pay own way)

▲ - Vacation

— — — 1% increase in travelers for 1% fare decrease.

— — — Breakeven line

Source: Gallup Poll of 4,467 adults conducted for American Express as reported in Aviation Daily, September 12, 1975, p. 70

FIGURE 3

FARE REDUCTION EFFECT ON AIR TRAVELERS

$$Pax_2 = Pax_1 \times \left(\frac{1.00}{1.00 + .10}\right)$$

$$Pax_2 = Pax_1 \ (0.9090909)$$

This indicates there is little to be gained economically from a fare reduction, but a great deal to be gained economically from a fare increase within fare elasticity limits.

Estimated traffic and financial data are summarized in Table 9 for a fare level equal to the present (March 1975) Piedmont Airlines CHO-DCA fare.

CHO-IAD AIR FEEDER SERVICE INITIATION

Cardinal Airlines initiated an air feeder service between Lynchburg, Virginia, Charlottesville, Virginia, and Dulles Airport on 15 September 1975 with a single 15-passenger Beech 99 aircraft. There were six round trips per day between Charlottesville and Dulles, and three of these continued on to Lynchburg and return. The fare (including 8% ticket tax) was $26 one way. There were no flights on Saturday. The schedule is shown in Table 10.

An estimate was made of the CHO-IAD market forecast for the published Cardinal Airlines service pattern, using the Estimated Hourly Passenger Flows (Table 4) and Estimated Market Penetration For Each Flight Connection (Figure 1) from this study. The results are shown in Table 11. Note that this is only for the Charlottesville - Dulles market. The Lynchburg market is not included because we have no forecasts of that route.

Table 9
ESTIMATED TRAFFIC AND FINANCIAL DATA
(1975 CHO-IAD Market)

	Hourly Service	2-Hour Service	Pax L.F. ≥ 30%	Peak Demand
TRAFFIC DATA				
Total market/yr	47,013	47,013	47,013	47,013
Avail. Pax/yr	30,576	21,528	23,712	23,088
Pax carried/day	90	65	67	66
Pax carried/yr	28,080	20,280	20,904	20,592
Market penetration	60 %	43 %	44 %	44 %
Annual O.W. flights	9,984	4,992	4,368	3,744
Annual seat trips	79,872	39,936	34,944	29,952
Aver. Pax L.F.	35 %	51 %	60 %	69 %
Lost business-seats	8 %	6 %	12 %	11 %
Lost business-sched	7 %	26 %	19 %	20 %
FINANCIAL DATA				
Gross revenue/yr	$598,104	$431,964	$445,255	$438,609
A/C total cost	$262,800	$131,400	$262,800	$262,800
Net fare	$ 21.30	$ 21.30	$ 21.30	$ 21.30
Aver. Revenue/flt	$ 59.90	$ 86.53	$ 101.94	$ 117.15
Est. TOC/yr	$262,800	$131,400	$262,800	$262,800
Est. ROI	128 %	229 %	69 %	67 %
Yield - ¢/ASM	8.9	12.9	15.2	17.4
MISCELLANEOUS				
Aircraft	(2)C402B	(1)C402B	(2)C402B	(2)C402B
Seats	8	8	8	8
O.W. Statute miles	84	84	84	84
Flight days/yr	312	312	312	312
Aircraft util.-hr/yr	3,328	3,328	1,456	1,248

Table 10
CARDINAL AIRLINES SCHEDULE
September 1975

DEPART	ARRIVE	FREQ.	FLIGHT	STOPS
FROM LYNCHBURG, VA.				
TO:				
Washington, D. C.	Dulles Airport	($39.00)*		
7:00 am	8:19 am	Ex.Sa.Su.	202	1
11:53 am	1:12 pm	Ex.Sa.	206	1
4:46 pm	6:05 pm	Ex.Sa.	210	1
Charlottesville, Va.	($25.00)*			
7:00 am	7:30 pm	Ex.Sa.Su.	202	0
11:53 am	12:23 pm	Ex.Sa.	206	0
4:46 pm	5:16 pm	Ex.Sa.	210	0
FROM CHARLOTTESVILLE, VA.				
TO:				
Washington, D. C.	Dulles Airport	(26.00)*		
7:45 am	8:19 am	Ex.Sa.Su.	202	0
9:25 am	9:59 am	Ex.Sa.Su.	204	0
12:38 pm	1:12 pm	Ex.Sa.	206	0
2:18 pm	2:52 pm	Ex.Sa.	208	0
5:31 pm	6:05 pm	Ex.Sa.	210	0
7:11 pm	7:45 pm	Ex.Sa.	212	0
Lynchburg, Va.	($25.00)*			
11:05 am	11:38 am	Ex.Sa.Su.	205	0
3:58 pm	4:31 pm	Ex.Sa.	209	0
8:51 pm	9:24 pm	Ex.Sa.	215	0

FROM WASHINGTON, D. C. DULLES AIRPORT				
TO:				
Lynchburg, Va.	($39.00)*			
10:14 am	11:38 am	Ex.Sa.Su.	205	1
3:07 pm	4:31 pm	Ex.Sa.	209	1
8:00 pm	9:24 pm	Ex.Sa.	215	1
Charlottesville, Va.	($26.00)*			
8:34 am	9:10 am	Ex.Sa.Su.	203	0
10:14 am	10:50 am	Ex.Sa.Su.	205	0
1:27 pm	2:03 pm	Ex.Sa.	207	0
3:07 pm	3:43 pm	Ex.Sa.	209	0
6:20 pm	6:56 pm	Ex.Sa.	211	0
8:00 pm	8:36 pm	Ex.Sa.	215	0

*All Fares are one-way and include Federal Transportation Tax.

Table 11
CHO-IAD PASSENGER MARKET FORECAST FOR CARDINAL AIRLINES SERVICE SCHEDULE
(September 1975 Schedule)

	First 6 Months*	Mature
Daily CHO-IAD pax	20.6	27.4
Daily IAD-CHO pax	23.1	30.9
Daily Round Trip	43.7	58.3
Gross Annual Revenue net of 8% Ticket Tax	$328,000	$437,000
Monthly one-way passengers	1125	1500
Pax Load Factor	24.2%	32.2%
Break-even pax load factor	48%	48%
Monthly one-way passengers to break even	2246	2246

*Only about 75% of mature demand should be expected during the early phases of a new service such as this.

APPENDICES

APPENDIX A
RICHMOND DIRECT MAIL SURVEY
Travel Questionnaire

SUMMARY

An attempt was made to obtain traveler data from a pre-selected demographic sampling of Richmond, Virginia, homeowners. This was done by mailing out 1700 questionnaires through the services of a direct mail marketing company. The "list broker" used was Communications Corporation of America (CCA), Culpeper, Virginia.

The objective of the program was two-fold:

(1) Evaluate the direct mail method of obtaining questionnaire responses

(2) Obtain some bonafide amodal travel habit data from a pre-selected demographic sampling of Richmond homeowners.

The program was inconclusive regarding both objectives because of the poor response rate of 12.1% (206 usable responses). This was felt to be caused by the failure of the list broker to include pre-paid postage on the reply envelopes, as specified in the contract. This, coupled with some extra expenses due to the research nature of the program, resulted in a cost per response of $4.85, which is not felt to be cost effective or representative.

A production mailing using first-class postage and "Dear Friend" letters of transmittal with the questionnaires would cost about 39.86¢ each, or $398.60 per thousand. A response rate of 24% would seem reasonable, and would result in a cost per response of $1.60.

The method was 94% accurate at pre-selecting the homeowner's sex, 46% accurate at pre-selecting his age bracket, but only 35% accurate at pre-selecting his income bracket. Only 14%

were simultaneously accurate on all three characteristics. Fifteen point nine percent of the letters were undeliverable.

There was no significant difference in the response rates from the various mailing methods, which included the four combinations of first-class and third-class postage, with computerized personal letters and "Dear Friend" letters. The first-class postage with "Dear Friend" letters would be the preferred method for administrative reasons.

The questionnaire data have not been completely analyzed at this writing, but appear to be very good quality, even though small in quantity. The respondents were generally very candid and helpful with their replies.

CONCLUSIONS AND RECOMMENDATIONS

Unfortunately, no conclusions or recommendations can be made regarding this method of data acquisition. The lack of pre-paid postage on the return envelopes obviously skewed the response rate data, which is critical to the cost-effectiveness of this method. The reader must be left to judge for himself, from this report, whether the method would be of value to him or not.

STUDY RESULTS

Mailing Lists

CCA said that of the 67 million households in the United States about 50 million were recorded on the tapes of the many direct mail marketing companies. Recorded data generally included names, age, sex, education, size of family, type of home, mortgage, automobiles, and income. Income data are the least accurate of the information available since they may frequently be estimated based on the individual's life style as perceived from the information available on him. The actual data available on each

individual or family will vary, depending upon the data source. Direct mail marketing companies, called "List Brokers," buy their information from many sources. These sources include credit card companies, magazine publishers, professional people, state tax and license offices, and the U. S. Census Bureau.

To obtain names and addresses from a list broker, the customer "rents" them for a one-time use. The terms of the contract prohibit the customer from using the names more than once. When responses are received by the customer from the mailing, however, the respondents' names and addresses may be used by the customer in any manner he chooses without further regard to the list broker. The customer may even sell them to other customers or perhaps even to a list broker. These names are especially valuable because they designate people who respond to direct mail contacts. Direct Mail/Marketing Association, Inc., 230 Park Avenue, New York, N. Y., 10017, is the trade association. Individuals may write them directly to put their own names on the lists, or to have their names completely removed from all mailing lists in the country.

CCA claimed to have 1.4 million names for rent within the Commonwealth of Virginia.

Demographic Selection

General travel surveys show that travelers have certain characteristics. For example, about 75% are men. Preselecting the demographic characteristics of the mailing would permit contacts with people at their convenience at home to obtain data with the same demographic characteristics as that obtainable from travelers en route.

The desired sex, age and income characteristics of the sampling undertaken for this program are shown in Table 1.

Table 1

DESIRED DEMOGRAPHIC CHARACTERISTICS

Richmond Direct Mail Travel Survey

Sex		Age		Income	
Male	76%	21-30	25%	<$ 10,000	20%
Female	24%	31-50	50%	10K-19,999	40%
		>50	25%	20K-29,999	30%
				30K-39,999	7%
				>$ 40,000	3%
	100%		100%		100%

Other demographic characteristics could have been pre-selected, such as education, number of automobiles, etc., but the individual data cell sizes would have become too small for statistical significance, because of the small size of the total mailing for this sampling.

The demographic selections made for this program are not normally used in ordinary direct mail marketing. A special computer subroutine had to be written by CCA in order to obtain the various combinations of addressee characteristics in the desired proportions. This was of course an extra cost.

Mailing Methods

The mailing consisted of a questionnaire, a one-page letter of transmittal intended to motivate the addressee to respond, and a pre-addressed business reply envelope. The return envelope was intended to be pre-paid, but CCA failed to do this. Consequently, the respondents had to apply their own ten-cent stamps. This was not only an imposition on the respondents and drastically decreased the response rate, but greatly embarrassed the University of Virginia and the program sponsor.

First-class, live stamps on outside envelopes and computerized, personal letters attract more attention than third-class, metered postage and "Dear Friend" letters, according to the direct mail marketing industry. They are also more expensive.

This mailing included both methods in four combinations to evaluate their cost-effectiveness. Additional incentives, such as a free gift of some convenient but trivial item was discussed but rejected because an additional variable would make the data cells too small for statistical significance.

Questionnaire

A four-page questionnaire was prepared especially for this program, following established questionnaire theory, and based on previous travel questionnaires prepared and used by the University of Virginia. The Department of Psychology of the University of Virginia provided valuable assistance in preparing the questionnaire. A copy is provided at the conclusion of this appendix.

The objective of the questionnaire was to obtain data on Virginia travelers' short-haul, intercity, amodal transportation needs and opinions by sampling a small number of Richmond, Virginia homeowners. The questionnaire was arranged to obtain certain demographic data about the respondent to classify the answers,to obtain opinions of the service characteristics currently provided by air, rail and rubber-tired transport modes, and solicit views on needed improvements. There were some questions which indicated the validity of the answers. Some questions were open so as not to lead the respondent in any way (very time consuming to analyze) and some were multiple choice to provide specific answers about specific characteristics. The questionnaire was not slanted in any way regarding any particular mode, such as air or rail. The respondent had the choice of either remaining anonymous or signing the questionnaire. Less than 5% chose to remain anonymous.

Two thousand questionnaires were the most which could be mailed out. At the expected 45% return rate, this would have resulted in a few less than 1000 responses, which had been approved by the U. S. Office of Management and Budget for this NASA sponsored program. The actual number sent out, and the actual number returned are discussed in the Response Rate section below.

Letter of Motivation

A letter was included with the questionnaire to explain its purpose and help motivate the addressee to reply.

Half of the letters were addressed to "Dear Friend," and the other half were computer addressed to the addressee by name. The contents of the two letters were identical. The letter was intended to acknowledge the imposition upon the addressee for the time spent, to relate the program to the addressee's needs, and to express sincere appreciation. An additional motivation factor was felt to be the University of Virginia return address on the outside envelope and letterhead. A copy is provided at the end of this appendix.

Response Rate

The University of Virginia provided 1700 questionnaires to CCA. Of these, 206 usable responses were received, for a return rate of 12.1%. At the $1,000 contract cost, this amounted to $4.85 per response, which is not felt to be cost-effective.

The low response rate was felt to be caused in part by the lack of a prepaid return envelope. There is no way to know the actual effect on response rate this factor had.

The $1,000 included expensive computer letters and first-class postage, however, as well as more economical "Dear Friend" letters and third-class postage. It also included the minimum rental of 5,000 names, of which only 1700 were actually used.

An estimate of costs for a production, first-class mailing of 5,000 questionnaires with "Dear Friend" letters would be $1,994, or 39.86¢ each, as shown in Table 2. Ten cents per response must be added for return postage. Computer letters would add $85/M ($425 total) to the cost.

Table 2

COST OF 5000 DIRECT MAIL QUESTIONNAIRES

August 1974

Item	Unit Cost	Cost
Name/address rental and labels	$ 33.32/M	$ 166.60
8½ x 11 "Dear Friend" letters	55.00/M	275.00
4-page questionnaires	75.00/M	371.33
#6 3/4 metered business reply envelopes	21.25/M	106.25
#10 window envelopes	23.00/M	115.00
Cut and fold letters	2.00/M	10.00
Insert for first-class	6.50/M	32.50
Affix live stamp	3.75/M	18.75
First-class postage	100.00/M	500.00
Affix address label (Cheshire)	3.50/M	17.50
Set-up charge	-	80.00
Special computer programming	-	300.00
TOTAL		$1,992.93

A 12% response rate would result in 600 responses at a cost of $3.42 per response. This is not felt to be cost effective. If $1.00 per response is the cost-effectiveness objective, then a response rate of 44% would be required (2214 responses). Even with a pre-paid return envelope, such a high response rate would be very optimistic, according to CCA. This program was undertaken on the understanding that a response rate of about 45% could be expected. CCA has since said that the estimate was "4 to 5%," and that the "45%" was a misunderstanding. If pre-paid return envelopes doubled the response rate from that obtained in this sampling, the cost would be $1.60 per response, which would be more reasonable.

Of the 1000 letters mailed first-class in this sampling, 15.9% were undeliverable for various reasons and were returned to the University of Virginia. Undeliverable third-class mail is not returned, of course, so it was assumed to have the same undeliverable rate.

The time required for the responses to be returned was very good. Eighty-eight percent of the total responses had been received by the end of the third week from date of postmark, and 93% by the fourth week. The remainder continued dribbling in for two months after the postmark date.

A three-digit code was placed on the address label to identify the sex, age and income level of the addressee for later evaluation of the method's accuracy at pre-selecting these characteristics. CCA was very accurate regarding the sex of the head of household (94%), less accurate for age (46%) and least accurate (as was expected) for income level (35%). These data are shown in Table 3. Of the 72 responses evaluated for accuracy, only 14% were simultaneously accurate on all three characteristics.

Table 3
DEMOGRAPHIC ACCURACY
Richmond Direct Mail Survey
(72 Responses)

Sex		Age		Income	
				Very High	13
		High	21	High	19
Correct	94%	Correct	46%	Correct	35%
Incorrect	6	Low	33	Low	22
				Very Low	11
	100%		100%		100%

Note: 14% were simultaneously correct on all three items

Only the block with the "Dear Friend" letters could be evaluated for accuracy. This was because the coded address labels were placed on the return envelopes in this group. For the computer letters the addresses were not labels at all but typed directly on the letters without codes. The letters of transmittal of course were not returned with the questionnaires. In both cases, the outside envelope was a window envelope allowing the address to be seen and serve double duty. A two-digit code was placed on the business reply envelopes to indicate the class of mailing and the type of letter sent. The response rates in each of the four categories were evaluated to see which methods were most effective. As shown in Table 4, there was so significant differences among the four categories.

The recommended mailing method, based on this limited sampling, would be first-class (to have letters forwarded or returned) with a "Dear Friend" letter of transmittal (much less expensive than computerized letters, and the return envelopes then have the respondents' name, address and pre-selected demographic coding).

Data Analysis

The data have not yet been fully analyzed.

Table 4
EFFECT OF MAILING METHOD
Richmond Direct Mail Survey
(220 total responses)

	Code			
	11	13	21	23
Type Letter	Computer	Computer	Dear Friend	Dear Friend
Mail Class	1 st	3 rd	1 st	3 rd
Number Mailed	500	500	500	200
Number Responses	66	62	65	27
Response Rate	13.2 %	12.4 %	13.0 %	13.5 %

Note: Of the 220 responses, only 206 were usable, for a rate of 12.1 %

UNIVERSITY OF VIRGINIA
SCHOOL OF ENGINEERING AND APPLIED SCIENCE
CHARLOTTESVILLE
22901

DEPARTMENT OF ENGINEERING SCIENCE
AND SYSTEMS
THORNTON HALL

Dear Friend:

Do you believe that short, out-of-town trips today are more difficult, more expensive, and less convenient than they used to be? That bus, train, and airplane fares and gasoline costs are expensive? If so, then you can see why information about people's travel needs and desires is needed by transportation system planners if future transportation systems are to better satisfy your needs.

The planners must understand what is important to travelers, such as yourself, when you select a bus, a train, an airplane, or your own automobile for your short out-of-town business or pleasure trips.

The University of Virginia and the National Aeronautics and Space Administration are trying to find efficient, inexpensive ways of collecting this information. This is why we are contacting you directly by mail. We believe this method will provide the largest amount of the necessary information possible for the taxpayer's dollar.

We are not selling anything and there are no gimmicks. We are only after information and we need your help.

Please fill out the enclosed questionnaire. Frankly, it is too long. But the more transportation system planners know about your specific travel habits and opinions, the better job they can do. We hope you will agree.

Thank you for your time on behalf of the National Aeronautics and Space Administration and the University of Virginia.

Robin K. Ransone,
Visiting Associate Professor

O. M. B. No. 104-S 74001
Approval Expires 3-31-75

UNIVERSITY OF VIRGINIA

This questionnaire is part of an effort by the National Aeronautics and Space Administration and the University of Virginia to obtain information from the traveling public to be used in the design of future transportation systems. The goal is to identify your needs and desires so they can be better satisfied by future systems. This part of the study is intended to better define the traveler who makes short out-of-town trips and the factors important to his selection of air, bus, train, or his own automobile for these trips.

We would like only your first impression on each question, and you need not answer any questions that offend you.

Thank you for your help and cooperation.

1. Age _____ 2. Sex: ☐ Male ☐ Female

3. Approximate yearly household income (before taxes):

☐ Under $10,000
☐ $10,000 - $19,999
☐ $20,000 - $29,999
☐ $30,000 - $39,999
☐ $40,000 or more

4. Marital status:

☐ Single ☐ Married ☐ Not presently married, but supporting dependents

5. Primary occupation: (Check one)

☐ Homemaker
☐ Student
☐ Sales
☐ Craftsman, Mechanic
☐ Secretary, Clerical
☐ Professional
☐ Farming, Fishing, Forestry, etc.
☐ Manager, Official, Executive
☐ Other _____ (specify)

6. Education: (Check your highest level of achievement)

☐ Some high school
☐ High school graduate
☐ Some college
☐ College graduate
☐ Advanced college degree(s)

7. Do you consider yourself to be an "experienced traveler"?

☐ Yes ☐ No

8. Short out-of-town trips have been defined in different ways. Please check the definition which best suits you, or indicate your own definition. (These are one-way times and distances.) (Please check only one.)

☐ Less than 200 miles
☐ Less than 500 miles
☐ Less than one day away from home
☐ Less than one hour travel time
☐ Less than two hours travel time
☐ Other _____

9. By the description you indicated above, how often do you usually make short out-of-town trips?

☐ Never
☐ Less than 6 times a year
☐ 6 to 12 times a year
☐ More than 12 times a year

10. Do other members of your family accompany you on short out-of-town business trips?

☐ Frequently ☐ Occasionally ☐ Never

11. Who usually pays for your short out-of-town business trips?

☐ Company ☐ I do ☐ Other _____

Who usually pays for your short out-of-town personal trips?

☐ I do ☐ Other _____

12. Please fill in the table below for five recent short out-of-town trips you can recall:

Trip	Route	Main Mode	Purpose of Trip	Length of Stay
1	From: ..... To:	☐ Auto ☐ Train ☐ Airplane ☐ Bus ☐ Metroliner	☐ Business ☐ Personal business ☐ Pleasure	☐ 1 day or less (not overnight) ☐ 1 - 3 days ☐ More than 3 days
2	From: ..... To:	☐ Auto ☐ Train ☐ Airplane ☐ Bus ☐ Metroliner	☐ Business ☐ Personal business ☐ Pleasure	☐ 1 day or less (not overnight) ☐ 1 - 3 days ☐ More than 3 days
3	From: ..... To:	☐ Auto ☐ Train ☐ Airplane ☐ Bus ☐ Metroliner	☐ Business ☐ Personal business ☐ Pleasure	☐ 1 day or less (not overnight) ☐ 1 - 3 days ☐ More than 3 days
4	From: ..... To:	☐ Auto ☐ Train ☐ Airplane ☐ Bus ☐ Metroliner	☐ Business ☐ Personal business ☐ Pleasure	☐ 1 day or less (not overnight) ☐ 1 - 3 days ☐ More than 3 days
5	From: ..... To:	☐ Auto ☐ Train ☐ Airplane ☐ Bus ☐ Metroliner	☐ Business ☐ Personal business ☐ Pleasure	☐ 1 day or less (not overnight) ☐ 1 - 3 days ☐ More than 3 days

13. What is your opinion of the following for short trips? (If you have no impressions concerning particular items, please so indicate.)

Intercity bus? _____

Train? _____

Metroliner? _____

Automobile? _____

Interstate airline? _____

Small commuter airline? _____

Jet vs. propeller airplane? _____

Large vs. small airplane? _____

14. How often do you find it necessary to spend a night at your destination due to the limitations of the transportation available to you?

☐ Frequently ☐ Occasionally ☐ Never

15. For your short business trips, check the time period during which you normally prefer to do the following:

	No Preference	Early Morning	Late Morning	Early Afternoon	Late Afternoon	Early Evening	Late Evening
Leave your home or office	☐	☐	☐	☐	☐	☐	☐
Return to home or office	☐	☐	☐	☐	☐	☐	☐
Arrive at destination	☐	☐	☐	☐	☐	☐	☐
Leave destination	☐	☐	☐	☐	☐	☐	☐

16. If you could conveniently accomplish your short out-of-town travel on **public transportation** for a reasonable price, have 6 hours available in which to conduct your business, and return, all within the hours of 7:00 A.M. and 7:00 P.M. in a single day, would this be of sufficient value so that you would use **public transportation** for most of your trips?

☐ No, would always prefer auto

☐ No, time span too long; would accept _____ A.M. to _____ P.M.

☐ Probably

☐ Certainly

☐ Certainly; would even be willing to increase time span to _____ A.M. to _____ P.M.

17. Among your acquaintances who make short out-of-town business trips, which factors do you consider to be most important in influencing their choice of whether they fly, drive their own automobile, go by train, or go by bus?

☐ Salary ☐ Job Status ☐ Reason for Trip ☐ Trip Convenience

☐ Cost ☐ Time Savings ☐ Other _____

18. About how often have you used the following types of transportation for your short out-of-town trips during the past year, and about how long were the trips?

	Trips per year			Approximate one-way miles for majority of trips			
Main Mode	Never	1-6	Over 6	Under 50	50-100	100-200	200-500
Private automobile	☐	☐	☐	☐	☐	☐	☐
Intercity bus	☐	☐	☐	☐	☐	☐	☐
Train	☐	☐	☐	☐	☐	☐	☐
Metroliner	☐	☐	☐	☐	☐	☐	☐
Small commuter airline	☐	☐	☐	☐	☐	☐	☐
Other commercial airline	☐	☐	☐	☐	☐	☐	☐

19. Indicate the importance of each of the following factors in your decision to select a particular type of transportation for a short out-of-town trip for the purpose indicated:

	Business Trips			Pleasure Trips		
	Not Important	Moderately Important	Very Important	Not Important	Moderately Important	Very Important
Comfort	☐	☐	☐	☐	☐	☐
Cost	☐	☐	☐	☐	☐	☐
Convenience	☐	☐	☐	☐	☐	☐
Dependability of service	☐	☐	☐	☐	☐	☐
Time savings	☐	☐	☐	☐	☐	☐
Safety	☐	☐	☐	☐	☐	☐
Ability to work or read en route	☐	☐	☐	☐	☐	☐

20. What services are important to you for short trips to other cities:

	No Importance	Desirable	Essential
Baggage checking	☐	☐	☐
Reservations	☐	☐	☐
Connections to other airlines, trains or buses	☐	☐	☐
Food/snacks en route	☐	☐	☐
Food/snacks at terminal, station or depot	☐	☐	☐
Coffee/soft drinks en route	☐	☐	☐
Cocktails en route	☐	☐	☐
Auto parking at origin	☐	☐	☐
Auto rental at destination	☐	☐	☐
Taxi at destination	☐	☐	☐
Public transportation at origin	☐	☐	☐
Public transportation at destination	☐	☐	☐

21. Everyone has his own opinions about different types of transportation. We are interested in your opinion even if you have not used each type. If you are seriously dissatisfied with any of the characteristics of the types of transportation listed below, place an "X" in each box that applies. For example, if you feel that the "safety" and "traffic congestion" of the private automobile is so poor that it would make you look for some other way to go, place an "X" in those boxes.

	Safety	Seat comfort	Leg room	Shoulder room	Cabin temp.	Dependability	Convenience	Cost	Travel time	Cleanliness	Good schedules	Traffic congest.	Ability to relax	Other
Private automobile														
Intercity bus														
Train														
Metroliner														
Small commuter airline														
Other commercial airline														
Small propjet airplane														
Small jet airplane														

22. Can you think of any question or comment you feel is important that we have not asked? If so, would you please explain? _____

_____

_____

Sometimes it is helpful to follow-up on some questions. If you wish, you may include your name and address, but it is not necessary:

Name: _____ Telephone: _____

Address: _____

WE GREATLY APPRECIATE THE TIME & TROUBLE YOU HAVE TAKEN TO ANSWER THESE QUESTIONS. THANK YOU.

APPENDIX B

UNIVERSITY TRAVEL ASSOCIATED WITH SPONSORED RESEARCH GRANTS

30 JUNE 72 - 30 JUNE 73

Procedure for Data Collection:

Travel vouchers from sponsored research expenditures at the University of Virginia from 30 June 72 to 30 June 73 were reviewed in order to obtain data in accordance with a preliminary objective of the Virginia Commuter Airline Project. That objective being to determine the volume of "potential airline traffic" between Charlottesville, Va., and Washington, D. C.

From each voucher the following information was derived: 1) Date of departure 2) Date of return 3) Destination 4) Route of travel 5) Mode of travel 6) Person making trip 7) Whether or not ticket purchased through a travel agent. (Data on individuals only used to cross-check vouchers for duplication.)

Not all travel vouchers were written in the same manner. In some instances a trip was deduced by noting expenses incurred in another city by an individual living in Charlottesville and working for the University. In these cases the name of the individual incurring the expenses and the date of the expenditures were compared with travel agency invoices in an effort to determine the route of the trip. In all cases air transportation was determined as the mode of travel. If the route of the trip could not be determined by comparison with travel agency invoices a notation was made indicating that transportation was by air and most likely through Washington National or Dulles airports.

A summary of the findings is shown in the tables which follow.

CHARLOTTESVILLE TO WASHINGTON

(One Way Only)

	CONNECTING WITH DCA	CONNECTING WITH DULLES	DESTINATION WASHINGTON
STATE CAR	18	10	53
PRIVATE CAR	29	75	308
RENTAL CAR	14	72	25
AIR	235	52	92
TRAIN	0	0	29
BUS	4	4	10
UNKNOWN	4	26	0
SUBTOTAL	304	239	517
	25.3 PAX/Month	19.9 PAX/Month	43.1 PAX/Month
	.83 PAX/Day	.66 PAX/Day	1.42 PAX/Day

Probable DCA or Dulles connecting - 142

TOTAL AIR RELATED TRAFFIC - - - 777
(DCA-Connecting+Dulles-Connecting+ 64.8 PAX/Month
Dest-Wash-Air+Probable DCA or Dulles 2.13 PAX/Day
Connecting)

WASHINGTON TO CHARLOTTESVILLE
(One Way Only)

	CONNECTING WITH DCA	CONNECTING WITH DULLES	DESTINATION CHARLOTTESVILLE
STATE CAR	18	10	53
PRIVATE CAR	28	75	308
RENTAL CAR	15	73	25
AIR	235	52	92
TRAIN	0	0	30
BUS	4	4	9
UNKNOWN	4	26	0
SUBTOTAL	304	240	517
	25.3 PAX/Month	20.0 PAX/Month	43.1 PAX/Month
	.83 PAX/Day	.66 PAX/Day	1.42 PAX/Day

Probable DCA or Dulles connecting - 142

TOTAL AIR RELATED TRAFFIC - - - 778
(DCA-Connecting+Dulles-Connecting+ 64.8 PAX/Month
Dest-Wash-Air+Probable DCA or Dulles 2.13 PAX/Day
Connecting)

COMPARISON WITH CAB PASSENGER SURVEY DATA
(YEAR ENDING 30 JUNE 73)

CHARLOTTESVILLE TO WASHINGTON

	ALL PAX TRAFFIC*	UVA.	% OF ALL PAX TRAFFIC
TOTAL	20120	379[1]	1.9%
		454[2]	2.3%
LOCAL	4340	92[3]	2.1%

WASHINGTON TO CHARLOTTESVILLE

TOTAL	19310	379	2.0%
		454	2.4%
LOCAL	4570	92	2.0%

*Local traffic is one way and has its entire directional journey between the city pair shown. Total traffic includes local and connecting traffic where connecting traffic is that which travels between the city pair shown, but that portion being a part of a longer interline itinerary. Total traffic is also one way. All CAB data taken from CAB Table 10, Second Quarter 1973.

[1]UVA. TOTAL TRAFFIC = (DCA-CONNECT-AIR) + (DULLES-CONNECT-AIR) + (DEST-WASH-AIR)

[2]Second figure for UVA. total traffic includes 75 passengers from probable DCA or Dulles connecting traffic. This figure is the same percentage of probable DCA or Dulles connecting traffic as is the "Air" portion of Dulles-Connect and DCA-Connect combined.

[3]UVA. LOCAL TRAFFIC = (DEST-WASH-AIR)

CHARLOTTESVILLE TO :
(One Way Trips)

	RICHMOND	BYRD AIRPORT	HAMPTON - NEWPORT NEWS
STATE CAR	32	0	63
PRIVATE CAR	298	24	53
RENTAL CAR	5	1	2
TRAIN	0	0	0
BUS	2	0	0
SUBTOTAL	337	25	118
	28.1 PAX/Month	2.08 PAX/Month	9.83 PAX/Month
	.92 PAX/Day	.07 PAX/Day	.32 PAX/Day

CHARLOTTESVILLE FROM :
(One Way Trips)

	RICHMOND	BYRD AIRPORT	HAMPTON- NEWPORT NEWS
STATE CAR	32	0	63
PRIVATE CAR	298	24	53
RENTAL CAR	5	2	2
TRAIN	0	0	0
BUS	2	0	0
SUBTOTAL	337	26	118
	28.1 PAX/Month	2.16 PAX/Month	9.83 PAX/Month
	.92 PAX/Day	.07 PAX/Day	.32 PAX/Day

CITIES CONNECTED WITH :

FREQUENCY	CITY	FREQUENCY	CITY
48	SAN FRANCISCO	8	MADISON, WISC.
39	BOSTON	7	MINNEAPOLIS
35	KNOXVILLE	7	NEW YORK
34	CHICAGO	6	TALLAHASSEE
31	DENVER	6	TUCSON
30	LOS ANGELES	6	FLINT, MICH.
25	AUSTIN	4	DETROIT
25	OVERSEAS	4	HARTFORD
22	MIAMI	4	BIRMINGHAM
19	DALLAS	4	SAN ANTONIO
19	CLEVELAND	4	KANSAS CITY
18	ALBUQUERQUE	4	PITTSBURGH
18	BUFFALO	3	MILWAUKEE
17	NEW ORLEANS	3	ALBANY
15	SAN DIEGO	3	PROVIDENCE
15	HOUSTON	3	SALT LAKE CITY
14	ST. LOUIS	3	OKLAHOMA CITY
13	PHILADELPHIA	3	SEATTLE
12	COLUMBUS	3	JACKSONVILLE
		66	MISCELLANEOUS ($\leq$2)

Summation of frequency of visits of all cities is greater than summation of connecting traffic (DCA-Connect, Dulles-Connect, Byrd-Connect) because some trips included stops at more than one destination, ex. CHO/DULLES/ALBUQUERQUE/ LOS ANGELES/DULLES/CHO.

Probable DCA or Dulles Connecting cities not included.

APPENDIX C

AIR TRAFFIC DATA FROM BLUERIDGE TRAVEL AGENCY 30 JUNE 72 - 30 JUNE 73

Procedure For Data Collection:

Ticket: Stubs from all airline tickets issued by Blueridge Travel for the year 30 June 72 to 30 June 73 were examined in order to obtain data in accordance with a preliminary objective of the Virginia Commuter Airline Project. From each ticket stub the date of departure, date of return, destination, and route of travel were recorded.

Only those trips with segments through Dulles or Washington National were recorded. These data have also been corrected for flights already noted in the University Research Travel Survey.

Many tickets start and/or end from either National or Dulles. In these cases the assumption is made that the trip originated or was terminated in Charlottesville since Blue-Ridge Travel handled the ticket and is located in Charlottesville.

NUMBER OF AIRLINE TRIPS
30 JUNE 72 TO 30 JUNE 73

Total Number of Trips

Departing Dulles (Origin Charlottesville)	1004
83.7 PAX/Month 2.8 PAX/Day	
Arriving Dulles (Destination Charlottesville)	929
77.4 PAX/Month 2.6 PAX/Day	
Departing DCA (Origin Charlottesville)	1386
115.5 PAX/Month 3.8 PAX/Day	
Arriving DCA (Destination Charlottesville)	1261
105.1 PAX/Month 3.5 PAX/Day	

TOTAL AIR TRAFFIC BETWEEN
CHO AND DCA OR DCA TO CONNECT
WITH DULLES

CHO → DCA	881	73.4 PAX/Mo	2.4 PAX/Day
DCA → CHO	803	66.9 PAX/Mo	2.2 PAX/Day

NUMBER OF TRIPS BY OTHER MODES
OF TRANSPORTATION TO CONNECT
WITH DCA OR DULLES

CHO → WASH	1509	125.8 PAX/Mo	4.1 PAX/Day
WASH → CHO	1387	115.6 PAX/Mo	3.8 PAX/Day

	FLYING	OTHER	TOTAL
CHO → IAD	16	988	1004
CHO → DCA (Connecting)	753	521	1274
CHO WASH (Destination)	112	0	112

CHO - DCA LOCAL TRAFFIC*

CHO → DCA	112
DCA → CHO	119

COMPARISON WITH CAB PASSENGER SURVEY DATA (YEAR ENDING 30 JUNE 73)

CHO → DCA

	ALL PAX TRAFFIC*	BLUERIDGE	%
TOTAL	20120	881	4.4
LOCAL	4340	112	2.6

DCA → CHO

TOTAL	19310	803	4.2
LOCAL	4570	119	2.6

*Local traffic is one way and has its entire directional journey between the city pair shown.

Total traffic includes local and connecting traffic where connecting traffic is that which travels between the city pair shown, but that portion being a part of a longer interline itinerary. Total traffic is also one way. All CAB data taken from CAB Table 10, Second Quarter 1973.

COMPARISON WITH CAB PASSENGER SURVEY DATA
(BLUERIDGE AND UVA. TRAVEL)

CHO → DCA

	ALL PAX TRAFFIC	BLUERIDGE AND UVA	%
TOTAL	20120	1260	6.3
LOCAL	4340	204	4.7

DCA → CHO

TOTAL	19310	1182	6.2
LOCAL	4570	211	4.6

CITIES CONNECTED WITH:

Frequency	City	Frequency	City
393	OVERSEAS	30	SAN DIEGO
220	CHICAGO	30	HONOLULU
190	NEW YORK	29	NEW ORLEANS
172	DENVER	28	MINNEAPOLIS
155	BOSTON	28	COLUMBUS
151	SAN FRANCISCO	27	BUFFALO
139	DALLAS	27	INDIANAPOLIS
106	MIAMI	25	KANSAS CITY
94	ATLANTA	25	AUSTIN
83	PHILADELPHIA	23	TAMPA
80	LOS ANGELES	22	PHOENIX
67	CANADA	22	ROCHESTER
60	DETROIT	20	MILWAUKEE
58	HARTFORD	19	JACKSONVILLE
57	ST. LOUIS	19	BANGOR
53	ALBUQUERQUE	18	LAS VEGAS
51	PITTSBURGH	17	KNOXVILLE
50	HOUSTON	17	CHAMPAIGN
50	CLEVELAND	16	SAN ANTONIO
41	GRAND JUNCTION	15	MEXICO
37	SEATTLE	15	PROVIDENCE
36	TUCSON	15	ALBANY
15	SYRACUSE	11	MEMPHIS
14	LOUISVILLE	10	SALT LAKE CITY
13	BIRMINGHAM	10	WILMINGTON
13	OKLAHOMA CITY	10	ITHICA
13	FORT LAUDERDALE	157	MISCELLANEOUS (<10)

APPENDIX D

RLES SPECIAL CODE

TRAVEL

(CHO → WASH)

	CONNECTING WITH DCA	CONNECTING WITH DULLES	DESTINATION WASHINGTON
STATE CAR	2	3	12
PRIVATE CAR	3	2	11
RENTAL CAR	2	0	0
AIR	15	0	4
TRAIN	0	0	2
BUS	0	0	0
UNKNOWN	2	3	1
SUBTOTAL	24	8	30

(WASH → CHO)

	CONNECTING WITH DCA	CONNECTING WITH DULLES	DESTINATION CHARLOTTESVILLE
STATE CAR	2	3	12
PRIVATE CAR	3	2	11
RENTAL CAR	2	0	0
AIR	14	0	3
TRAIN	0	0	1
BUS	0	0	1
UNKNOWN	1	3	1
SUBTOTAL	22	8	29

APPENDIX E

AIR TRAFFIC DATA FROM: Dean's Office
School of Engineering, Applied Math and
Computer Science, Engineering Science and Systems
30 JUNE 72 - 30 JUNE 73

CHO TO WASHINGTON

	CONNECTING WITH DCA	CONNECTING WITH DULLES	DESTINATION WASHINGTON
PRIVATE CAR	3	6	6
RENTAL CAR	3	0	0
BUS	0	0	0
TRAIN	2	1	0
STATE CAR	0	0	4
AIR	10	4	0
	18	11	10

WASHINGTON TO CHO

	CONNECTING WITH CHO	CONNECTING WITH DULLES	DESTINATION CHARLOTTESVILLE
PRIVATE CAR	3	8	6
RENTAL CAR	3	0	0
BUS	0	0	1
TRAIN	0	0	0
STATE CAR	0	0	4
AIR	7	4	0
	13	12	11

APPENDIX F

SUMMARY

PASSENGERS OUTBOUND FOR WASHINGTON

(FROM CHARLOTTESVILLE)

	ALL MODES	AIR	% AIR	% OTHER
UVA. RESEARCH	1060	379	35.8	64.2
BLUE RIDGE	2390	881	36.9	63.1
RLES	62	19	30.7	69.3
MISC.	39	14	35.9	64.1
TOTAL	3551	1293	36.4	63.6

ALL PAX TRAFFIC CHO → DCA (CAB TABLE 10) 20120

(30 JUNE 72 - 30 JUNE 73) SAMPLE 1293

% SAMPLE 6.4

	ALL REASONS ALL MODES	AIR AND TO CONNECT WITH AIR	% AIR AND CONNECT	% OTHER
UVA. RESEARCH	1060	635	59.9	40.1
BLUE RIDGE	2390	2390	100.0	0.0
RLES	62	36	58.1	41.9
MISC.	39	29	74.4	25.6
TOTAL	3551	3090	87.0	13.0

PERCENT OF SAMPLE MAKING AIR CONNECTION IN WASHINGTON BUT TRAVELING FROM CHARLOTTESVILLE TO WASHINGTON BY MODES OTHER THAN AIR -

UVA. RESEARCH	24.1%
BLUE RIDGE	63.1%
RLES	19.4%
MISC.	38.5%
AVERAGE	50.6%

NOTE:
Add to more than 100% due to some people being counted more than once

UVA. SAMPLE

	FLYING	%	OTHER	%	TOTAL	%
IAD	72	5.7	1190	94.3	1262	100
DCA	1013	62.5	607	37.5	1620	100
WASH	208	31.1	461	68.9	669	100
TOTAL	1293	36.4	2258	63.6	3551	100